PATENT ABSTRACTS OF JAPAN

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(54) SURFACE ILLUMINATION DEVICE

(57)Abstract:
PURPOSE: To increase brightness while maintaining the uniformity over the entire surface of a light diffusion plate without increasing the thickness over the entire part of a light reflection plate by devising the surface shape of the light diffusing plate.
CONSTITUTION: This surface illumination device is constituted by having a transparent plate 2, a reflection plate 4 laminated on the rear surface of this transparent plate 2 and the light diffusing plate 6 laminated on the front surface of the transparent plate 2, providing an irregular reflection layer 3 between the transparent plate 2 and the reflection plate 4 and disposing a light source 8 for irradiating the inside of the transparent plate 2 with light on the lateral end face of the transparent plate 2. Plural dotty projections 7 which are regularly arranged and have light condensing and diffusing functions are formed on the surface of the above-mentioned light diffusion plate 6 on the side opposite from the transparent plate 2. Then, the light transmitted

through the transparent plate 2 is effectively condensed by the respective dotty projections 7 and the light condensed in such a manner is efficiently diffused and, therefore, the brightness is made higher than heretofore while the desired uniformity is maintained without increasing the total thickness.

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CLAIMS

[Claim(s)]

[Claim 1] While having the transparence plate 2, the reflecting plate 4 which carries out a laminating to the rear face of this transparence plate 2, and the optical diffusion plate 6 which carries out a laminating to the front face of said transparence plate 2 and forming the scattered reflection layer 3 between said transparence plates 2 and said reflecting plates 4 Area-light equipment which carries out the description of forming condensing arranged regularly and two or more dot-like projections 7 with a diffusion function to an anti-opposed face with said transparence plate 2 in said optical diffusion plate 6 in the area-light equipment which has arranged the light source 8 which

irradiates light in this transparence plate 2 in the side edge side of said transparence plate 2.
[Claim 2] Area-light equipment according to claim 1 which makes the dot-like projection 7 formed in the optical diffusion plate 6 the shape of a semi-sphere.
[Claim 3] Claim 1 which is arranging alternately two or more dot-like projections 7 formed in the optical diffusion plate 6, and area-light equipment given in two.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to area-light equipment and the area-light equipment used for a liquid crystal display etc. in detail.
[0002]
[Description of the Prior Art] As it is indicated by JP, 58-38186, U, for example and is conventionally shown in drawing 7 and drawing 8 as this kind of area-light equipment While forming in one field of the transparence plate A the scattered reflection layer B which consists of the fine spot of a large number to which scattered reflection of the light is carried out and making the rear face of said transparence plate A carry out the laminating of the reflecting plate C to the letter of adhesion by using this scattered reflection layer B as a rear face The front face of said transparence plate A is made to carry out the laminating of the optical diffusion plate D which has the irregularity to which a configuration changes from an unspecified crepe pattern to one field to the letter of adhesion, the light sources E and E are arranged in the both-sides side face of said transparence plate A, and what illuminated uniformly and brightly the whole surface of said optical diffusion plate D is known.
[0003]
[Problem(s) to be Solved by the Invention] By the way, when the area-light equipment constituted as mentioned above is used for a liquid crystal display, An operator needs to enable it to recognize liquid crystal displays, such as **** expressed all over a liquid crystal display plate, a numeric value, and a pattern, with uniform vision,

therefore it crosses all over a liquid crystal display plate. By homogeneity It is requested that the brightness more than predetermined is maintained. And moreover Not only in when seeing liquid crystal displays expressed to said liquid crystal display plate, such as **** and a numeric value, from a right angle to the screen core of said display plate Even when seeing to the upper and lower sides and right and left to said screen core within the limits of a predetermined ********** angle of visibility (generally 60 degrees), what can be recognized with uniform vision is desired.

[0004] However, with the area-light equipment by which the conventional proposal is made, it migrated to all the front faces of a liquid crystal display plate, and sufficient high brightness could not be obtained, maintaining regularity, but there was a problem which is not made to recognize a liquid crystal display easily with uniform vision in the range of an angle of visibility.

[0005] Moreover, although two or more sheet laminating of said optical diffusion plate is carried out or what performed crimp processing to the front flesh side of an optical diffusion plate, and formed the crepe pattern is proposed as an approach of solving the above problem In any case, condensing effectiveness is low, and the problem which still runs short of the brightness in the range of an angle of visibility remains, and cannot perform recognition with uniform vision enough over all the front faces of a liquid crystal display plate.

[0006] In this invention, when this problem was pursued, it traced that a difficulty was in the optical diffusion plate D which carries out a laminating to the front face of said transparence plate A. That is, although it has a certain amount of condensing diffusion since this optical diffusion plate D performs crimp processing and makes it the crepe pattern so that regularity may be obtained, there is no regular condensing function, therefore there is much unevenness, and a condensing operation also has it, and it traces that brightness runs short, and invents paying attention to an optical diffusion plate.

[inadequate]

[0007] This invention aims at offering the area-light equipment which can make brightness high on the whole surface of an optical diffusion plate, without devising the shape of surface type of an optical diffusion plate, and the thickness of the whole equipment becoming thick, in order to solve the above-mentioned trouble.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, while this invention is equipped with the transparence plate 2,

the reflecting plate 4 which carries out a laminating to the rear face of this transparence plate 2, and the optical diffusion plate 6 which carries out a laminating to the front face of said transparence plate 2 and forms the scattered reflection layer 3 between said transparence plates 2 and said reflecting plates 4 In the side edge side of said transparence plate 2, two or more dot-like projections 7 which have condensing arranged regularly and a diffusion function in an anti-opposed face with said transparence plate 2 in said optical diffusion plate 6 were formed in the area-light equipment which has arranged the light source 8 which irradiates light in this transparence plate 2.
[0009] Moreover, as for the dot-like projection 7 formed in said optical diffusion plate 6, it is desirable to form in the shape of a semi-sphere.
[0010] Moreover, as for two or more dot-like projections 7 formed in said optical diffusion plate 6, arranging alternately is desirable.
[0011]
[Function] Since the dot-like projection 7 which has condensing which plurality described above, and a diffusion function in an anti-opposed face with the transparence plate 2 of said optical diffusion plate 6 was arranged regularly and formed Since the light which was made to condense effectively the light which has passed said transparence plate 2 by said dot-like projection 7, and condensed can be diffused When the brightness in the range of an angle of visibility can be made high, therefore it applies to a liquid crystal display plate, maintaining regularity, recognition with uniform vision can be easily performed over all the front faces of this liquid crystal display plate.
[0012] Moreover, when forming said dot-like projection 7 in the shape of a semi-sphere, while better condensing is attained according to the lens effectiveness, diffusion of the light in each projection 7 will be performed efficiently, and on the whole, brightness can be raised more, maintaining regularity.
[0013] moreover, said each dot-like projection 7 -- since the consistency of length, width, and said dot-like projection 7 occupied in the whole area since it sets aslant and is moreover mostly made to homogeneity at the minimum can be increased for spacing during each projection 7 by arranging .... alternately, on the whole, condensing and diffusion can be performed good, and improvement in brightness is raised further.
[0014]
[Example] Drawing 1 shows a part of cross section of the area-light equipment of this invention. The transparence plate 2 of 4-5mm thickness which consists mainly of acrylic resin, The reflecting plate 4 which

carries out a laminating to the letter of adhesion through the spot 31 which forms the scattered reflection layer 3 which carries out a postscript all over the rear face of this transparence plate 2, The 1st light diffusion plate 5 which becomes a letter of adhesion from the polycarbonate which carries out a laminating, polyester resin, etc. on the front face of said transparence plate 2, Form a light guide plate 1 with the 2nd light diffusion plate 6 which has the description of this invention, and the light sources 8 and 8 of an incandescent lamp, a fluorescent light, etc. are arranged to the both-ends side of this light guide plate 1. It constitutes so that the light which irradiates in said transparence plate 2 and carries out incidence into this transparence plate 2 may illuminate the light from said light source 8 on said 2nd light diffusion plate 6 whole surface.

[0015] In the above configuration in addition, said scattered reflection layer 3 It forms in the rear face which is an opposed face with said reflecting plate 4 of said transparence plate 2. This scattered reflection layer 3 A majority of said fine spots 31 whose height is about 30 micrometers, for example are printed so that a specific pattern may be drawn by screen-stencil etc. with the white coating of gloss **** which mixed the minute glass bead. It is made to carry out scattered reflection of a part of light which carries out incidence into said transparence plate 2 from said light source 8. In this case, although it is desirable to make it the shape of a semi-sphere, other configurations are sufficient as it, and homogeneity distribution is sufficient as it, although a spot consistency may be made to become dense as the configuration of said spot 31 keeps away to said light sources 8 and 8.

[0016] Moreover, although said 1st light diffusion plate 5 is an optical diffusion plate in the conventional example from which a configuration equips the front face used as the anti-opposed face of said transparence plate 2 with the irregularity of an unspecified crepe pattern, and the whole serves as opalescence and especially this 1st light diffusion plate 5 is not required for it, using, when improving regularity is desirable.

[0017] Next, said 2nd light diffusion plate 6 which is the description of this invention is explained. This 2nd light diffusion plate 6 forms two or more dot-like projections 7 which have condensing arranged regularly and a diffusion function in an anti-opposed face with said transparence plate 2 using resin sheets, such as polycarbonate resin and polyester resin, like the 1st light diffusion plate 5.

[0018] the die pressing according [this dot-like projection 7] to this embossing roll using an embossing roll -- carrying out -- the example

which was fabricated and was shown in drawing 1 thru/or drawing 3 -- the diameter of about 40 micrometers -- it presupposed that it is hemispherical, and like drawing 3 , it was alternate and a majority of each [these] dot-like projections 7 were arranged regularly.
[0019] When it is desirable at the point that the thickness of a light guide plate 1 can be stopped and fabricates using an embossing roll so that thickness including the dot-like projection 7 of said 2nd light diffusion plate 6 is thin, it is set to 100-200 micrometers. Moreover, when a hemispherical diameter is set to 40 micrometers, as for the pitch of said dot-like projection 7, considering as 40-micrometer pitch is desirable, but even if it makes it larger than 40-micrometer pitch, it does not interfere. Moreover, although between the dot-like projections 7 which adjoin as shown in drawing 2 may be fabricated in the shape of flatness when making it larger than 40-micrometer pitch, it is good also as a reverse R configuration which follows said dot-like projection 7.
[0020] When a deer is carried out and incidence of the light is carried out into said transparence plate 2 from said light source 8, in the light guide plate 1 constituted as mentioned above light Said each spot [in / it goes on carrying out total reflection within said transparence plate 2, and / in this light / said transparence plate 2] 31 .... When a formation location is reached, Reflect irregularly by ...., or hit said reflecting plate 4 directly and it reflects. this spot 31 -- passing -- said reflecting plate 4 side of said transparence plate 2 -- coming out -- said each spot 31 -- Repeat refraction reflection, and in the account transparence plate 2 of back to front, incidence is carried out and it spreads at homogeneity at said 1st light diffusion plate 5. Furthermore, light diffuses from this 1st light diffusion plate 5, and it results in said 2nd light diffusion plate 6, and is efficiently condensed with this 2nd light diffusion plate 6, and the condensed light diffuses every dot-like projection 7, and said 2nd light diffusion plate 6 whole surface is brightly illuminated by homogeneity.
[0021] Incidentally, when compared about the regularity and the brightness of the light guide plate 1 which carried out the laminating of the 2nd light diffusion plate 6, and constituted it, the light guide plate 5, i.e., said 1st light diffusion plate, of said 1st example of this invention, and the conventional light guide plate which carried out the two-sheet laminating of said 1st light diffusion plate 5, the measurement result shown in Table 1 and 2 was obtained.
[0022] The same thing is being used for the comparison data of these light guide plates except said 2nd light diffusion plate 6, respectively. The magnitude of 5.7mm and the whole is 206mm wide and 149mm (the

magnitude of an effective light-emitting part) long about the total thickness of each light guide plate. As the two-point broken line shown in drawing 4 shows, the thing of die length of 205mm, the diameter of 3.0mm, and a 5W input is used for said light source 8 by the long side 2 LGT type as being 192mm wide and 144mm long.

[0023] And as shown in drawing 4 , in nine places at which axes of ordinate Y1, Y2, and Y3 and axes of abscissa X1, X2, and X3 are distributed to nine front faces in the core and periphery of each light guide plate, i.e., a light guide plate, so that spacing may become equal, respectively, and each [these] XY shaft crosses them, the brightness seen from a perpendicular direction to said light guide plate is measured. In addition, the measuring instrument to be used is TOPCON. BM-7 (TOPCON CORP. make) is used.

[0024] It is [0025] when the measurement result of the brightness about the light guide plate 1 of the 1st example is shown in Table 1.

[Table 1]

[0026] (unit: Becoming cd/m2), average luminance is 2354 cd/m2 in 88% of regularity. It became.

[0027] In addition, it is asking for regularity at (the minimum value of measured value) / (maximum of measured value) x100%.

[0028] Next, it is [0029] when the measurement result of the brightness about the conventional light guide plate is shown in Table 2.

[Table 2]

[0030] (unit: Becoming cd/m2), average luminance is 2071 cd/m2 in 84% of regularity. It became.

[0031] From the above result, the light guide plate 1 of this invention is understood [while regularity is the same (it is improving a little in the measurement result) mostly, it is moreover raised about 11.4% in average luminance and the regularity more than predetermined is maintained compared with the conventional thing, and] that brightness

is improving on the whole, making total thickness the same.
[0032] Moreover, the result of having changed and measured the include angle which tries to receive this light guide plate 1 in the brightness in the light guide plate 1 of this invention is shown below.
[0033] In drawing 4 , this light guide plate 1 is received in the center section of said light guide plate 1. First, centering on the direction of a right angle (location of the front face of a light guide plate 1 to 90 degrees) Each brightness when setting the brightness when inclining to the end-face side which arranges a for the brightness in each include angle when inclining the include angle to see to a longitudinal-direction, i.e., end face which is not arranging said light source 8, side, and is arranging the vertical direction 8, i.e., said light source, for the include angle to see to b is shown in Table 3.
[0034]
[Table 3]

[0035] When applying to a liquid crystal display plate generally, an angle of visibility is made into 60 degrees, what a liquid crystal display can recognize good with uniform vision to the location seen from a right angle to the screen core of said liquid crystal display plate within limits which were able to be shifted by a unit of 30 degrees in the direction of four directions is required, and the angle of visibility in Table 3 is within the limits of the 90 above mentioned include angles thru/or 60 degrees.
[0036] Moreover, the measuring point of the brightness in Table 3 is brightness 2208 cd/m2 of the center position which is the intersection of the axis of ordinate Y2 of drawing 4 , and an axis of abscissa X2, i.e., the center position shown by **, and was shown in Table 1. Brightness 2211 cd/m2 in the 90-degree location in Table 3 And 2216 cd/m2 Although it differs somewhat, these are measurement errors and a theory top will be in agreement.
[0037] Therefore, although brightness will fall a little to the above

mentioned upper and lower sides and the above mentioned angle-of-visibility limitation of a longitudinal direction if the brightness is seen in the angle-of-visibility range (90 - 60 degrees in Table 3) in the measurement result of Table 3 Within the limits of 40 angles of visibility (90 - 70 degrees in Table 3) (location of the front face of a light guide plate to 70 degrees), i.e., the angle of visibility usually used, there is almost no fall of brightness and predetermined brightness is obtained in the range of an angle of visibility.

[0038] In the example shown in drawing 1 thru/or drawing 3 , that desired regularity was obtained and the brightness has improved, making it the total thickness same like the above as the conventional example Since the dot-like projection 7 of a large number formed all over said 2nd light diffusion plate 6 is made hemispherical From having structure with which each [these] dot-like projection 7 carried out the operation of a lens, and the small lens was innumerably located in a line It is thought that it is because the light which could condense efficiently the light which passed said transparence plate 2 and the 1st light diffusion plate 5 by the lens effectiveness, and condensed in the range of an angle of visibility can be efficiently diffused in each dot-like projection 7.

[0039] Moreover, said dot-like projection 7 in this invention may not be limited in the shape of a semi-sphere as mentioned above, and may be formed truncated **** or in the shape of a truncated cone, and may be formed in a cylinder or a prismatic form.

[0040] One example is shown in drawing 5 and 6 among those. Drawing 5 and the example shown in 6 are what was formed in the shape of a truncated hexagon-head spindle, after opposed face spacing set to 40 micrometers at the maximum and makes the tilt angle of each side about 35 degrees, forms the circular crevice 71 with a diameter of 7.5 micrometers in a top-face center section, and arranges it regularly alternately like the 1st example which showed each [these] dot-like projection 7 to drawing 1 thru/or drawing 3 .

[0041] Said each dot-like projection 7 in this example can also improve brightness, without thickening total thickness, being able to fabricate with an embossing roll, and the same effectiveness as the 1st example being acquired by said each dot-like projection 7, and being able to obtain predetermined regularity.

[0042] In addition, improvement in brightness is obtained as compared with the case where it does not form, what said circular crevice 71 raised the optical diffuser efficiency in a top face, raises brightness, and formed this crevice 71 is circular, and also it is desirable to

consider as the cross-section configuration and analog of said dot-like projection 7.

[0043] Moreover, in the above configuration, the height of said dot-like projection 7 can be set up freely, and can also set up the pitch during each dot-like projection 7 corresponding to desired brightness, and it is not necessary to necessarily arrange it alternately.

[0044] Moreover, although the laminating of the 2nd light diffusion plate 6 which has said dot-like projection 7 to this 1st light diffusion plate 5 was carried out in said 1st example using the 1st light diffusion plate 5 of a crepe pattern, it is not necessary to use the 1st light diffusion plate 5. However, it can be made higher than the case where only said 2nd light diffusion plate 6 is used without using said 1st light diffusion plate 5 for brightness, by using said 1st light diffusion plate 5.

[0045]

[Effect of the Invention] Condensing which arranged the light guide plate of this invention regularly to the anti-opposed face with said transparence plate 2 in said optical diffusion plate 6 as explained above, Since two or more dot-like projections 7 with a diffusion function were formed and the light which was made to condense effectively the light which has passed said transparence plate 2 by said each dot-like projection 7, and carried out **** condensing can be diffused efficiently Brightness can be made higher than before, without thickening total thickness, maintaining desired regularity. Therefore, when it applies to a liquid crystal display plate, recognition with uniform vision can be easily performed over all the front faces of this liquid crystal display plate.

[0046] Moreover, when forming said dot-like projection 7 in the shape of a semi-sphere, while better condensing is attained according to the lens effectiveness, diffusion of the light in each projection 7 will be performed efficiently, and on the whole, brightness can be raised more, maintaining regularity.

[0047] moreover, said each dot-like projection 7 -- since the consistency of length, width, and said dot-like projection 7 occupied in the whole area since it sets aslant and is moreover mostly made to homogeneity at the minimum can be increased in spacing during each projection 7 by arranging .... alternately, on the whole, the condensing and diffusion can be performed more to fitness, and much more improvement in brightness is attained.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The area-light equipment of this invention is a notching sectional view a part.

[Drawing 2] The 2nd light diffusion plate in the 1st example is a notching sectional view a part.

[Drawing 3] The 2nd light diffusion plate in the 1st example is a notching plan a part.

[Drawing 4] The explanatory view showing the measuring point at the time of measuring the brightness of the light guide plate in the 1st example, and the conventional light guide plate.

[Drawing 5] The optical diffusion plate in the 2nd example is a notching sectional view a part.

[Drawing 6] The optical diffusion plate in the 2nd example is a notching plan a part.

[Drawing 7] The sectional view of conventional area-light equipment.

[Drawing 8] Conventional area-light equipment is a notching perspective view a part.

[Description of Notations]

2 Transparence Plate

3 Scattered Reflection Layer

4 Reflecting Plate

6 Optical Diffusion Plate (2nd Light Diffusion Plate)

7 Dot-like Projection

8 Light Source

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	5/02	Ｃ	9224－2K		
Ｇ０２Ｆ	1/1335	５３０	7408－2K		
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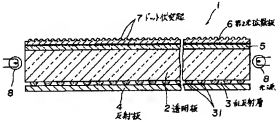
(54)【発明の名称】　面照明装置

(57)【要約】

【目的】光拡散板の表面形状を工夫して、導光板全体の厚みが厚くなることなく、光拡散板の全面において均斉度を保持しながら、輝度を高くする。

【構成】透明板２と、透明板２の裏面に積層する反射板４と、透明板２の表面に積層する光拡散板６とを備え、透明板２と反射板４との間に乱反射層３を設けると共に、透明板２の側端面に、透明板２内に光を照射する光源８を配置した面照明装置において、光拡散板６における透明板２との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起７を形成する。

【効果】透明板２を通過してきた光を各ドット状突起７で有効に集光させられ、かつ、斯く集光した光を効率よく拡散させることができるので、所望の均斉度を保ちながら、また、総厚を厚くすることなく、従来よりも輝度を高くすることができる。



【特許請求の範囲】

【請求項１】透明板２と、該透明板２の裏面に積層する反射板４と、前記透明板２の表面に積層する光拡散板６とを備え、前記透明板２と前記反射板４との間に乱反射層３を設けると共に、前記透明板２の側端面に、該透明板２内に光を照射する光源８を配置した面照明装置において、前記光拡散板６における前記透明板２との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起７を形成していることを特徴する面照明装置。

【請求項２】光拡散板６に形成するドット状突起７を半球状にしている請求項１記載の面照明装置。

【請求項３】光拡散板６に形成する複数のドット状突起７を千鳥状に配設している請求項１及び２記載の面照明装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、面照明装置、詳しくは液晶表示等に用いる面照明装置に関する。

【０００２】

【従来の技術】従来、この種の面照明装置としては、例えば実開昭５８－３８１８６号公報に開示され、また、図７及び図８に示すように、透明板Ａの一方の面に光を乱反射させる多数の細かい斑点から成る乱反射層Ｂを形成して、この乱反射層Ｂを裏面として前記透明板Ａの裏面に反射板Ｃを密着状に積層させると共に、前記透明板Ａの表面に、一方の面に形状が不特定の梨地模様から成る凹凸を有する光拡散板Ｄを密着状に積層させて、前記透明板Ａの両側側面に光源Ｅ，Ｅを配設して、前記光拡散板Ｄの全面を均一に、かつ、明るく照明するようにしたものが知られている。

【０００３】

【発明が解決しようとする課題】ところで、以上のように構成する面照明装置を液晶表示に用いる場合、液晶ディスプレイ板の全面に表現する文言、数値、パターン等の液晶表示を、オペレータが均一な視覚で認識できるようにする必要があり、そのために液晶ディスプレイ板の全面にわたり均一で、かつ、所定以上の輝度が維持されることが要望されており、しかも、前記液晶ディスプレイ板に表現する文言や数値などの液晶表示を、前記ディスプレイ板の表示面中心に対し直角方向から見る場合だけでなく、前記表示面中心に対し上下及び左右に所定角ずらせた視野角（一般には６０度）の範囲内で見る場合でも均一な視覚で認識できることが望まれている。

【０００４】ところが、従来提案されている面照明装置では、液晶ディスプレイ板の全表面にわたり、均斉度を保ちながら十分な高輝度を得ることができず、液晶表示を視野角の範囲において均一な視覚で容易に認識させられない問題があった。

【０００５】また、以上の問題を解消する方法として、前記光拡散板を複数枚積層したり、光拡散板の表裏にしぼ加工を施して梨地模様を形成したものも提案されているが、何れの場合も集光効果が低く、依然として視野角の範囲での輝度が不足する問題は残存しており、液晶ディスプレイ板の全表面にわたり均一な視覚での認識が十分行えないのである。

【０００６】本発明では、この問題を追求したところ、前記透明板Ａの表面に積層する光拡散板Ｄに難点があることをつきとめた。即ち、この光拡散板Ｄは、均斉度が得られるようにしぼ加工を施して梨地模様としているため、ある程度の集光拡散作用を有しているが、規則正しい集光機能はなく、そのためむらが多いし、また、集光作用も不十分で輝度が不足することを突き止め、光拡散板に着目して発明したものである。

【０００７】本発明は、上記問題点を解決するために、光拡散板の表面形状を工夫して、装置全体の厚みが厚くなることなく、光拡散板の全面において輝度を高くすることができる面照明装置を提供することを目的とする。

【０００８】

【課題を解決するための手段】本発明は上記目的を達成するために、透明板２と、該透明板２の裏面に積層する反射板４と、前記透明板２の表面に積層する光拡散板６とを備え、前記透明板２と前記反射板４との間に乱反射層３を設けると共に、前記透明板２の側端面に、該透明板２内に光を照射する光源８を配置した面照明装置において、前記光拡散板６における前記透明板２との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起７を形成したものである。

【０００９】また、前記光拡散板６に形成するドット状突起７は半球状に形成することが好ましい。

【００１０】また、前記光拡散板６に形成する複数のドット状突起７は千鳥状に配設することが好ましい。

【００１１】

【作用】前記光拡散板６の透明板２との反対向面に複数の前記した集光、拡散機能をもつドット状突起７を規則的に配列して形成したので、前記透明板２を通過してきた光を前記ドット状突起７で有効に集光させられ、かつ、集光した光を拡散させることができるので、均斉度を保ちながら視野角の範囲での輝度を高くすることができ、従って、液晶ディスプレイ板に適用した場合、この液晶ディスプレイ板の全表面にわたり均一な視覚での認識を容易に行うことができるのである。

【００１２】また、前記ドット状突起７を、半球状に形成する場合には、レンズ効果によりより良好な集光が可能となると共に、各突起７での光の拡散が効率よく行われることとなり、均斉度を保ちながら全体的により輝度を向上させることができる。

【００１３】また、前記各ドット状突起７‥‥を千鳥状に配設することにより、各突起７間の間隔を縦、横、斜めにおいてほぼ均一にしかも最小限にできるので、全体の面積に占める前記ドット状突起７の密度を増すことが

できるので、全体的に集光及び拡散を良好に行うことができ、輝度の向上を一層高められるのである。

【００１４】

【実施例】図１は本発明の面照明装置の横断面の一部を示したものであって、４～５ｍｍ厚の主としてアクリル樹脂から成る透明板２と、この透明板２の裏面全面に後記する乱反射層３を形成する斑点３１を介して密着状に積層する反射板４と、前記透明板２の表面に密着状に積層するポリカーボネートやポリエステル樹脂などからなる第１光拡散板５と、本発明の特徴を有する第２光拡散板６とにより導光板１を形成し、この導光板１の両端面に白熱電球、蛍光燈などの光源８，８を配置して、前記光源８からの光を前記透明板２内に照射し、該透明板２内に入射する光が、前記第２光拡散板６全面において照明するように構成したものである。

【００１５】尚、以上の構成において、前記乱反射層３は、前記透明板２の前記反射板４との対向面である裏面に形成したものであって、この乱反射層３は、微小のガラスビーズを混入したツヤ消しの白色塗料によりスクリーン印刷などで特定のパターンを描くように細かい例えば高さが３０μｍ程度の前記斑点３１を多数印刷して、前記光源８から前記透明板２内に入射する光の一部を乱反射させるようにしているのである。この場合、前記斑点３１の形状は、半球状にするのが好ましいが、他の形状でもよいし、また、前記光源８，８に対し遠ざかるに従って斑点密度を密になるようにしてもよいが均一分布でもよい。

【００１６】また、前記第１光拡散板５は、前記透明板２の反対向面となる表面に形状が不特定の梨地模様の凹凸を備え、全体が乳白色となっている従来例での光拡散板であって、この第１光拡散板５は特に必要でないが、均斉度を向上する上で用いるのが好ましい。

【００１７】次に本発明の特徴である前記第２光拡散板６について説明する。この第２光拡散板６は、第１光拡散板５と同様ポリカーボネート樹脂やポリエステル樹脂などの樹脂シートを用い、前記透明板２との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起７を形成したものである。

【００１８】このドット状突起７は、例えばエンボスロールを用い、該エンボスロールによる型押しにより成形するのであって、図１乃至図３に示した実施例では直径約４０μｍの半球状とし、かつ、これら各ドット状突起７を、図３のように千鳥状で規則的に多数配設したのである。

【００１９】前記第２光拡散板６のドット状突起７を含む厚さは、薄いほど導光板１の厚さを抑えられ点で好ましいのであって、エンボスロールを用いて成形する場合には例えば１００～２００μｍとなる。また、前記ドット状突起７のピッチは、半球状直径を４０μｍとした場合、４０μｍピッチとするのが好ましいが、４０μｍピッチより大きくしても差し支えない。また、４０μｍピッチより大きくする場合、図２に示したように隣接するドット状突起７間を平坦状に成形してもよいが、前記ドット状突起７に連続する逆アール形状としてもよい。

【００２０】しかして、以上のように構成した導光板１において、前記光源８から前記透明板２内に光を入射させると、光は、前記透明板２内で全反射しながら進行し、この光が前記透明板２における前記各斑点３１・・・・の形成位置に至ったとき、該斑点３１を通過して、前記透明板２の前記反射板４側に出て、前記各斑点３１・・・・により乱反射したり、前記反射板４に直接あたって反射したりして、屈折反射を繰り返し、その後前記透明板２内に入射されて前記第１光拡散板５に均一に行きわたり、さらに、この第１光拡散板５から光が拡散されて、前記第２光拡散板６に至り、該第２光拡散板６により効率よく集光され、かつ、集光された光が各ドット状突起７ごとに拡散されるのであって、前記第２光拡散板６全面が明るく均一に照明されるのである。

【００２１】因に本発明の前記第１実施例の導光板、つまり、前記第１光拡散板５に、第２光拡散板６を積層して構成した導光板１と、前記第１光拡散板５を２枚積層した従来の導光板との均斉度及び輝度について比較してみると、表１及び表２に示す測定結果が得られた。

【００２２】これら導光板の比較資料は、それぞれ前記第２光拡散板６以外は同じものを使用しており、各導光板の総厚を５．７ｍｍ、全体の大きさが、横２０６ｍｍ、縦１４９ｍｍ（有効発光部の大きさは、図４に示す２点破線で示すように横１９２ｍｍ、縦１４４ｍｍである）として、前記光源８を長辺２灯式で、長さ２０５ｍｍ、直径３．０ｍｍ、５ワット入力のものを使用する。

【００２３】そして、図４に示すように、各導光板の中心及び周辺部における９箇所、つまり導光板の表面に、縦軸Ｙ１，Ｙ２，Ｙ３と、横軸Ｘ１，Ｘ２，Ｘ３とをそれぞれ等間隔が均等となるように配分してこれら各ＸＹ軸が交わる９箇所において、前記導光板に対し垂直方向から見る輝度を測定するのである。尚、使用する測定器は、ＴＯＰＣＯＮ　ＢＭ－７（トプコン社製）を使用している。

【００２４】第１実施例の導光板１についての輝度の測定結果を、表１に示すと、

【００２５】

【表１】

	Ｙ１	Ｙ２	Ｙ３
Ｘ１	２４９４	２４９３	２３９２
Ｘ２	２２７０	２２０８	２１９２
Ｘ３	２２８２	２４２１	２４３３

【００２６】（単位：ｃｄ／ｍ^2）となり、均斉度８８％で、平均輝度は、２３５４ｃｄ／ｍ^{2}となった。

【００２７】尚、均斉度は（測定値の最小値）／（測定値の最大値）×１００％で求めている。

【００２８】つぎに、従来の導光板についての輝度の測定結果を表２に示すと、

【００２９】

【表２】

	Ｙ１	Ｙ２	Ｙ３
Ｘ１	２２０３	２２３８	２１６８
Ｘ２	１８８８	１９８０	１８９７
Ｘ３	２０２４	２１１５	２１２８

【００３０】（単位：ｃｄ／m^2）となり、均斉度８４％で、平均輝度は、２０７１ｃｄ／m^2 となった。

【００３１】以上の結果から、本発明の導光板１は、従来のものに比べて均斉度はほぼ同じ（測定結果では若干向上している）で、しかも、平均輝度において約１１．４％向上させられ、所定以上の均斉度を保ちながら、また、総厚を同じにしながら全体的に輝度が向上しているのが分かる。

【００３２】また、本発明の導光板１における輝度を該導光板１に対し見る角度を変えて測定した結果を次に示す。

【００３３】まず、図４において、前記導光板１の中央部において、該導光板１に対し直角方向（導光板１の表面から９０度の位置）を中心に、見る角度を左右方向、即ち、例えば、前記光源８を配設していない端面側に傾いていったときの各角度における輝度をａ、また、見る角度を上下方向、即ち、例えば前記光源８を配設している端面側に傾いていったときの輝度をｂとしたときの各輝度を表３に示す。

【００３４】

【表３】

	ａ	ｂ
９０度	２２１１　ｃｄ／m^2	２２１８　ｃｄ／m^2
７０度	２０１５　ｃｄ／m^2	２０５８　ｃｄ／m^2
６０度	１７２９　ｃｄ／m^2	１７５１　ｃｄ／m^2
５０度	１３３２　ｃｄ／m^2	１３９６　ｃｄ／m^2
４０度	８５５　ｃｄ／m^2	１０５９　ｃｄ／m^2

【００３５】一般に液晶ディスプレイ板に適用する場合、視野角は６０度とされ、前記液晶ディスプレイ板の表示面中心に対し直角方向から見る位置に対し、上下左右方向に３０度ずつずらせた範囲内で、均一な視覚で液晶表示が良好に認識できることが要求されるのであって、表３における視野角は前記した角度９０度乃至６０度の範囲内である。

【００３６】また、表３における輝度の測定位置は、図４の縦軸Ｙ２、横軸Ｘ２の交点、つまり、㊇で示した中心位置であって、表１に示した中心位置の輝度２２０８ｃｄ／m^2 と表３における９０度位置での輝度２２１１ｃｄ／m^2 及び２２１６ｃｄ／m^2 とは多少異なるが、これらは測定誤差であって、理論上は一致することになる。

【００３７】従って、表３の測定結果での視野角範囲（表３における９０～６０度）で、その輝度をみてみると、前記した上下、左右方向の視野角限界では輝度が若干低下しているが、視野角（表３における９０～７０度）、つまり、通常使用される視野角４０度（導光板の表面から７０度の位置）の範囲内では、殆ど輝度の低下がないのであって、視野角の範囲において所定の輝度が得られるのである。

【００３８】図１乃至図３に示した実施例において、以上のごとく従来例と同じ総厚にしながら、所望の均斉度が得られて、その輝度が向上できたのは、前記第２光拡散板６の全面に形成した多数のドット状突起７を半球状としているから、これら各ドット状突起７がレンズの作用をし、小さなレンズが無数に並んだ構造となっていることから、前記透明板２及び第１光拡散板５を通過した光をレンズ効果で効率よく集光でき、かつ、視野角の範囲に集光した光を各ドット状突起７において効率良く拡散させることができることによるものと考えられる。

【００３９】また、本発明における前記ドット状突起７は、以上のように半球状に限定するものでなく、截頭角錐または截頭円錐状に形成してもよいし、また、円柱や角柱状に形成してもよい。

【００４０】そのうち一つの実施例を図５及び６に示す。図５，６に示した実施例は、截頭六角錐状に形成したもので、対向面間隔が最大で例えば４０μｍとし、各辺の傾斜角を例えば３５度程度とした上で、頂面中央部に例えば直径７．５μｍの円形凹部７１を形成し、これら各ドット状突起７を図１乃至図３に示した第１実施例と同様千鳥状に規則的に配設したものである。

【００４１】この実施例における前記各ドット状突起７

も、例えばエンボスロールにより成形できるのであって、前記各ドット状突起７により、第１実施例と同様の効果が得られ、所定の均斉度を得られながら、また、総厚を厚くすることなく輝度を向上できるのである。

【００４２】尚、前記円形凹部７１は、頂面での光拡散効率を高め、輝度を向上させるもので、この凹部７１を形成したものは、形成していない場合に比較して輝度の向上が得られるのであって、円形の他、前記ドット状突起７の横断面形状と相似形とするのが好ましい。

【００４３】また、以上の構成において、前記ドット状突起７の高さは自由に設定することができ、各ドット状突起７間のピッチも所望の輝度に対応して設定することができるし、必ずしも千鳥状に配設する必要はない。

【００４４】また、前記第１実施例では、梨地模様の第１光拡散板５を用いて、この第１光拡散板５に前記ドット状突起７を有する第２光拡散板６を積層したが、第１光拡散板５は用いなくともよい。しかし、前記第１光拡散板５を用いることにより、輝度を前記第１光拡散板５を使用せずに前記第２光拡散板６のみを使用する場合よりも高くすることができるのである。

【００４５】

【発明の効果】以上説明したように、本発明の導光板は、前記光拡散板６における前記透明板２との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起７を形成したから、前記透明板２を通過してきた光を前記各ドット状突起７で有効に集光させられ、かつ、斯く集光した光を効率よく拡散させることができるので、所望の均斉度を保ちながら、また、総厚を厚くすることなく、従来よりも輝度を高くすることができるのである。従って、液晶ディスプレイ板に適用した場合、この液晶ディスプレイ板の全表面にわたり均一な視覚での認識を容易に行うことができるのである。

【００４６】また、前記ドット状突起７を、半球状に形成する場合には、レンズ効果によりより良好な集光が可能となると共に、各突起７での光の拡散が効率よく行われることにより、均斉度を保ちながら全体的により輝度を向上させることができる。

【００４７】また、前記各ドット状突起７‥‥を千鳥状に配設することにより、各突起７間の間隔を縦、横、斜めにおいてほぼ均一にしかも最小限にできるので、全体の面積に占める前記ドット状突起７の密度を増大できるので、全体的にその集光及び拡散をより良好に行うことができ、輝度のより一層の向上が可能となる。

【図面の簡単な説明】

【図１】本発明の面照明装置の一部切欠断面図。

【図２】第１実施例における第２光拡散板の一部切欠断面図。

【図３】第１実施例における第２光拡散板の一部切欠上面図。

【図４】第１実施例における導光板と従来の導光板との輝度を測定する際の測定位置を示す説明図。

【図５】第２実施例における光拡散板の一部切欠断面図。

【図６】第２実施例における光拡散板の一部切欠上面図。

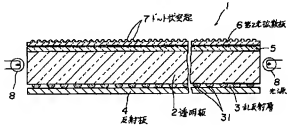
【図７】従来の面照明装置の断面図。

【図８】従来の面照明装置の一部切欠斜視図。

【符号の説明】

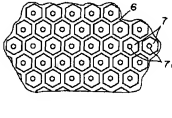
2　透明板
3　乱反射層
4　反射板
6　光拡散板（第２光拡散板）
7　ドット状突起
8　光源

【図１】

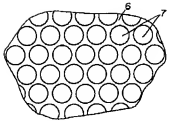


【図２】

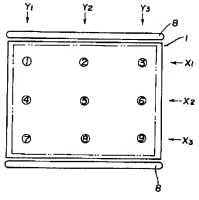
【図６】



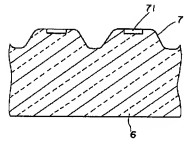
【図３】



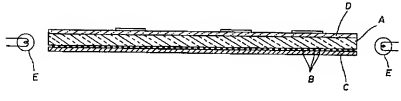
【図４】



【図５】



【図７】



【図８】